INSTRUCTION MANUAL

RAWS-F Remote Automated Weather Station for Fire Weather

Revision: 10/11

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RAWS-F Remote Automated Weather Station for Fire Weather

1. Introduction

The RAWS Quick Deployment Weather Station is a lightweight, pre-configured station that can be set up in less than 10 minutes—without tools (see Section 2—Getting Started). The aluminum environmental enclosure houses a 12 V rechargeable battery and a CR1000 datalogger mounted to a 6 ft tripod. The outside of the enclosure has color-coded, keyed connectors (Figure 1-1) for attaching the sensors. Besides the connectors, a wiring panel is included that allows the measurement of additional sensors. Communication options include satellite transmitter and voice radio interface module. Additional communication equipment (telephone, cellular phone, radio) can be added to the station. This station is ideal for prescribed burns or other temporary installations. The RAWS-F Quick Deployment Weather Station is shown in Figure 1-2.

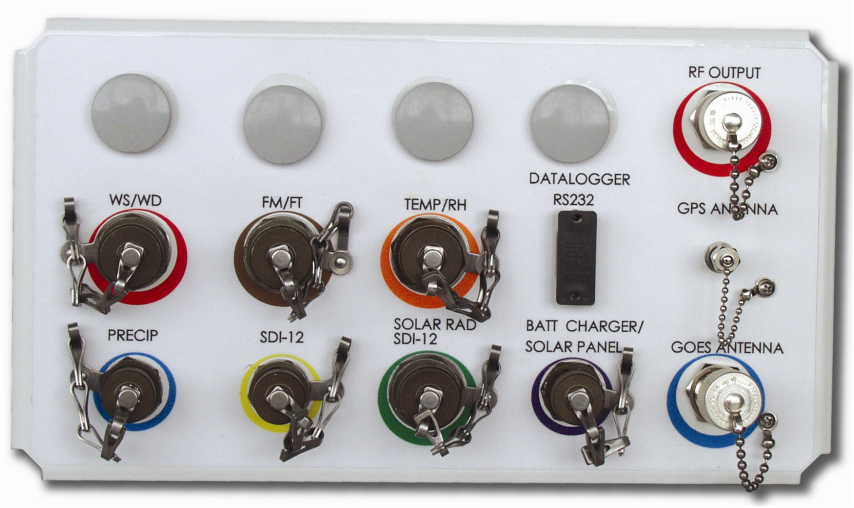


FIGURE 1-1. Color-coded, keyed connector panel

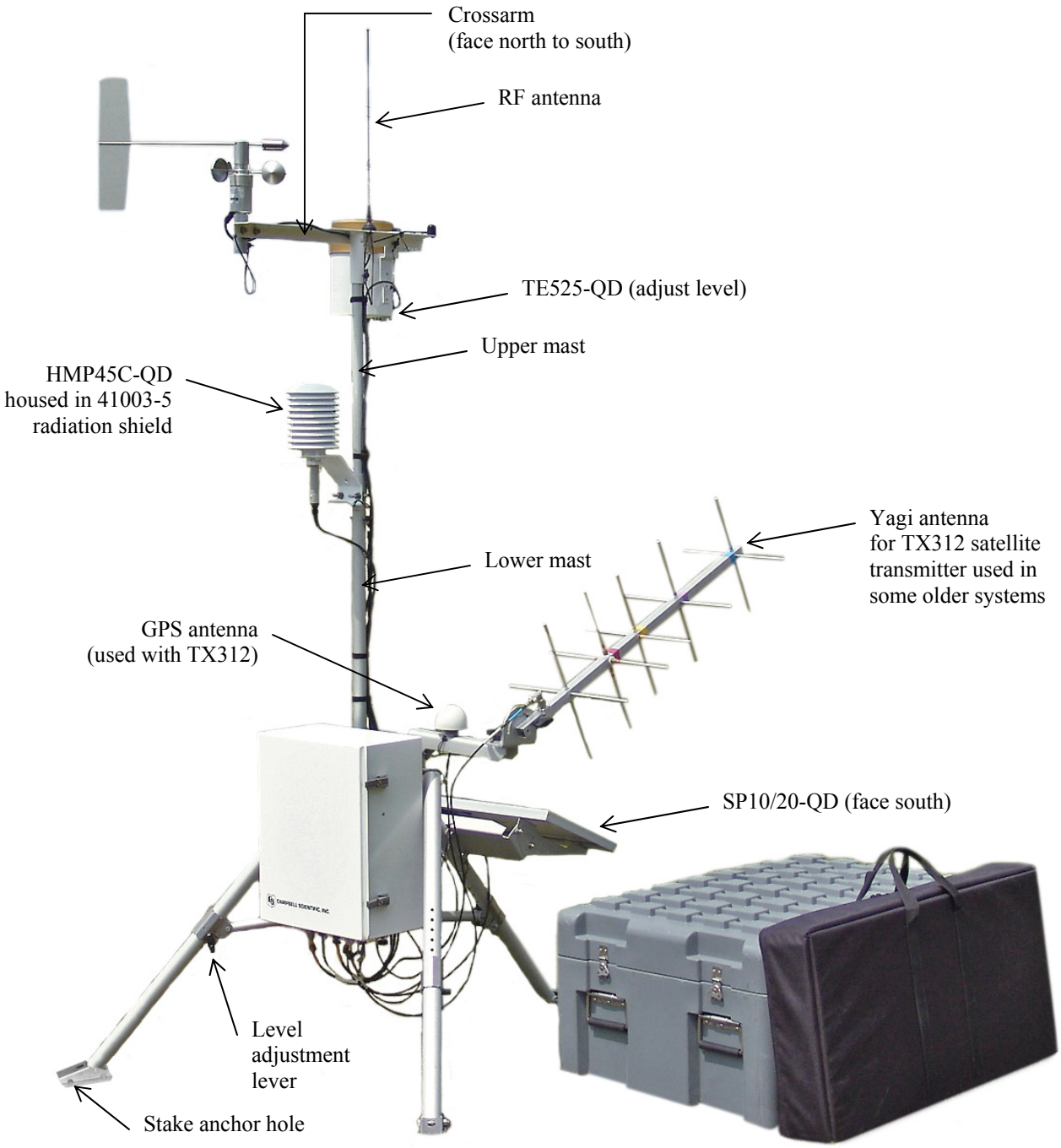


FIGURE 1-2. RAWS-F Quick Deployment Weather Station

2. Getting Started

NOTE Set up and test your station before field deployment.

NOTE Level the RAWS Quick Deployment Weather Station to ensure the sensors are level. Level the rain gage by adjusting the rain gage leveling screw. A post level and compass ship with the station (part #16670).

NOTE **Keep this manual and the CR1000KD Keyboard Display with the RAWS Quick Deployment Weather Station.** Review the station siting and orientation section before field deployment. If a problem is encountered, review the equipment wiring and troubleshooting sections in this manual.

NOTE Assemble the RAWS Quick Deployment Weather Station (Appendix A).

NOTE After siting and leveling the RAWS station, open the enclosure and (1) connect the battery cable and (2) verify the CH100 switch is in the 'on' position. **When this equipment is not in use (i.e., transport or storage), disconnect battery cable to the CH100.**

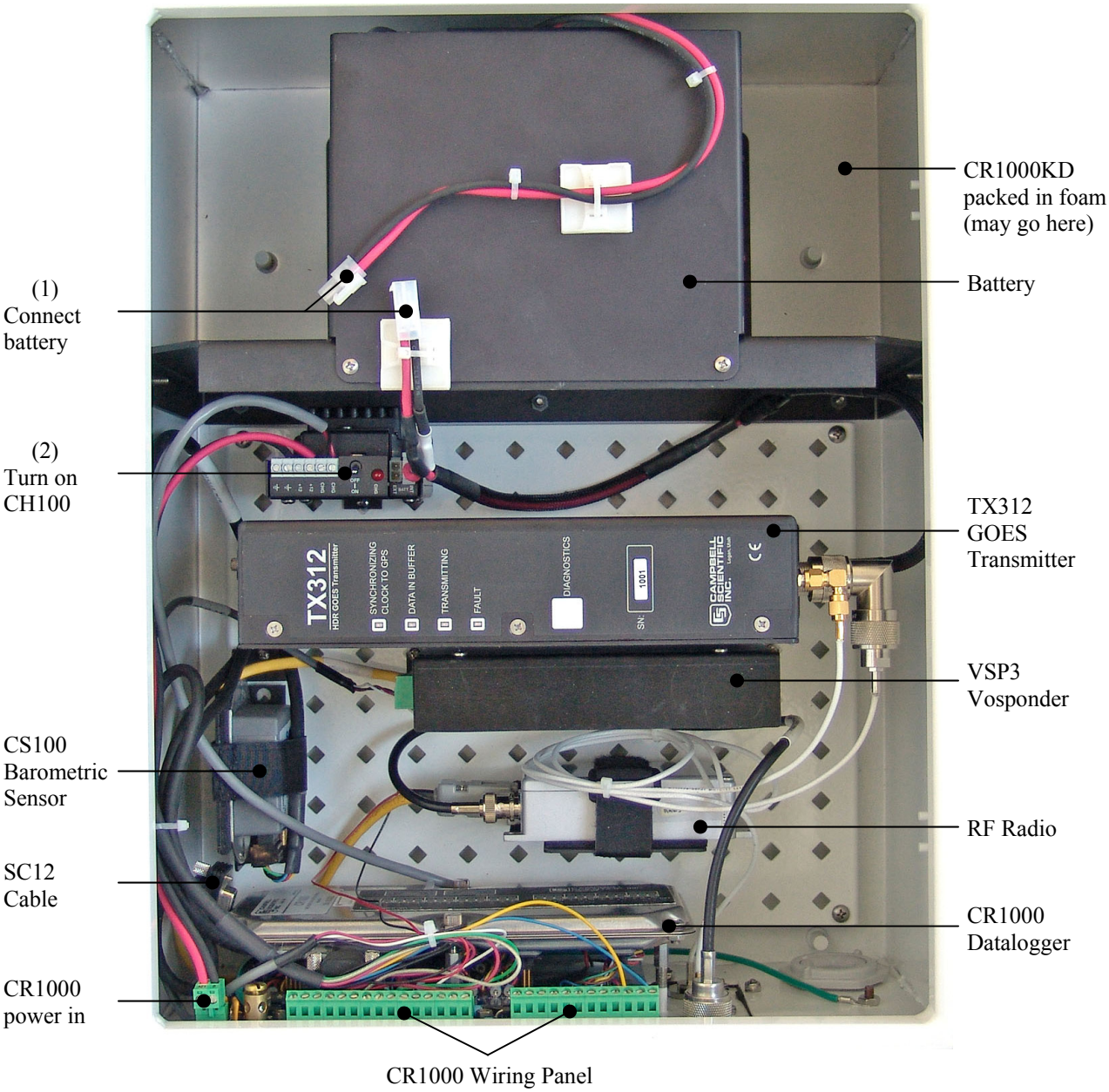


FIGURE 2-1. Inside environmental enclosure (optional equipment shown)

NOTE The RAWS Quick Deployment Weather Station comes pre-programmed, but this program does NOT include user-specific GOES-ID parameters. Please contact a Campbell Scientific Applications Engineer for programming assistance. Campbell Scientific company contact information is listed on the last page of this manual.

NOTE

Use the CR1000KD Keyboard Display to see the "Public Variables" shown in Table 2-1.

Press any key for Power up Screen
Press ^ to turn on/off backlight
Press <> to adjust contrast

- Connect the CR1000KD Keyboard Display to the CS I/O connector (Figure 5.7-2) or SC12 Cable (Figure 2-1)
- Press any key for the CR1000KD Power up Screen
- Press Enter to move down a menu (Press Esc to move up a menu)
- (Press up/down arrow to select item)
- Select Data, press Enter
- Select Real Time Tables, press Enter
- Select Public, press Enter
- Press up/down arrow to see the Public Variables listed in Table 2-1

TABLE 2-1. Public Variables

Number	Name	Function
	Sensor Variables	
1	Batt_Volt	System power supply voltage
2	AirTempF	HMP45C Air Temperature in Degrees F
3	RH	HMP45C Relative Humidity in Percent
4	TdewF	Dew point in Deg F, calculated from HMP45C data
5	SlrW	Solar Radiation in Watts, pyranometer
6	Rain_in	Temporary rain, cleared every scan
7	RainTot	TE525 Cumulative rain fall in inches
8	WS_mph	Wind Speed in MPH
9	WindDir	Wind Direction
10	WSDiag	Only for Wind Sonic data, zero otherwise
11	MaxWS	MaxWS, reset 2 minutes before transmit
12	MaxWD	Direction of wind during Max wind speed
13	SlrMJ	Solar Radiation in MJoules
14	BP_inHg	Hourly - Barometric pressure, inHg
15	BPelev_ft	Elevation, to correct Barometric pressure
16	FuelT_F	Hourly - Fuel temperature in degrees F
17	FuelM	Hourly - Fuel Moisture, % moisture by weight
	GOES Variables	
18	CountDwn	True or False: True indicates GPS fix good and program is collection data. False until GPS fix
19	Clockgood	True or False: True after GPS fix and CR1000 clock has been set to match TX312 clock
20	TimeToXmit	Seconds until transmit time. Indicates CR1000 and TX312 are properly setup and running
21	SWR	Standing Wave Ratio (SWR), only after a transmission. Indicates condition of antenna and cable. SWR should be less than 2.0
22	FwdPower	Forward Power in dBm, should be about 37
23	RefPower	Reflected power in dBm, should be about 25 or less
24	RC_Data	Only valid after first transmission. Anything other than zero is a problem
25	Setup_RC	Indicates if CR1000 could setup TX312. Zero is success or has not run

3. Station Siting and Orientation

3.1 General Description

Selecting an appropriate site for the RAWS Quick Deployment Weather Station is critical in order to obtain accurate meteorological data. In general, the site should be representative of the general area of interest and away from the influence of obstructions such as buildings and trees.

NOTE See Section 8 for siting references.

WARNING **If any part of the weather station comes in contact with power lines, you could be killed. Contact local utilities for the location of buried utility lines before digging or driving ground rods.**

3.2 Air Temperature and Relative Humidity

A temperature and relative humidity sensor should be located over an open level area at least 9 m in diameter (EPA). The surface should be covered by short grass, or where grass does not grow, the natural earth surface. The sensor must be housed inside a radiation shield and adequately ventilated.

Situations to avoid include: 1) large industrial heat sources, 2) rooftops, 3) steep slopes, 4) sheltered hollow, 5) high vegetation, 6) shaded areas, 7) swamps, 8) areas where snow drifts occur, and 9) low places holding standing water after rains.

3.3 Precipitation

A rain gauge should be located over an open level area covered by short grass, or where grass does not grow, the natural earth surface. Level the RAWS station to ensure the sensors are level. Level the rain gage by adjusting the rain gage leveling screw. A post level and compass ship with the RAWS station (part #16770).

NOTE Take off the funnel and remove the rubber band securing the tipping bucket mechanism during transport.

3.4 Solar Radiation

A solar radiation sensor should be located to avoid shadows on the sensor at any time. Orient the RAWS station where the solar radiation sensor faces south (northern hemisphere) minimizing the chance of shading from other weather station structures. Reflective surfaces and sources of artificial radiation should be avoided. Level the RAWS station to ensure the solar radiation sensor is level.

3.5 Wind Speed and Direction

A wind sensor should be located over open level terrain and at a distance of at least ten times (EPA) the height of any nearby building, tree, or other obstruction.

3.6 Barometric Pressure (optional)

The barometric pressure sensor is mounted to the back plate inside the RAWS environmental enclosure.

3.7 Fuel Moisture and Fuel Temperature (optional)

The fuel moisture and fuel temperature sensor should be left outside at the field site continually exposed to the same conditions as forest fuels. The fuel moisture and fuel temperature dowel rods absorb and desorb moisture from its surroundings. Install the probes horizontally on the mounting stake and face the sensors south (northern hemisphere) above a representative forest floor duff layer. Place the sensor away from foot traffic areas.

4. Sensor Maintenance, Calibration, and Troubleshooting

4.1 Maintenance

Proper maintenance of weather station components is essential to obtain accurate data. Equipment must be in good operating condition, which requires a program of regular inspection and maintenance. Routine and simple maintenance can be accomplished by the person in charge of the weather station. More difficult maintenance, such as sensor calibration, sensor performance testing (i.e., bearing torque), and sensor component replacement, generally requires a skilled technician, or send the instrument to Campbell Scientific. A station log should be maintained for each weather station that includes equipment model and serial numbers and maintenance that was performed.

NOTE Contact Campbell Scientific, Inc., phone (435) 753-2342, for an RMA number before returning sensor or equipment for service.

4.2 Air Temperature and Relative Humidity

4.2.1 General Description, Air Temperature and Relative Humidity (part #HMP45C-QD)

The Vaisala Air Temperature and Relative Humidity Sensor (part #HMP45C-QD) shown in Figure 4.2-1 contains a Platinum Resistance Temperature detector (PRT) probe and a Vaisala HUMICAP® 180 capacitive relative humidity probe. The probe output for each sensor is a voltage.

FIGURE 4.2-1. Air temperature and relative humidity

4.2.2 Wiring, Air Temperature and Relative Humidity (part #HMP45C-QD)

The temp/RH sensor is connected to the RAWS connector panel "TEMP/RH" connector COLOR CODED ORANGE. This sensor is internally wired from the RAWS connector panel to the CR1000 datalogger.

Connector Panel "TEMP/RH" connector COLOR CODED ORANGE

Connector Pin A	Temp Hi	to CR1000	1L
Connector Pin B	Sensor excitation	to CR1000	EX1
Connector Pin C	Sensor signal Lo/AG	to CR1000	AG
Connector Pin D	Power ground	to CR1000	Ground
Connector Pin E	RH signal	to CR1000	1H
Connector Pin F	SW_12V	to CR1000	SW_12V

4.2.3 Maintenance, Air Temperature and Relative Humidity (part #HMP45C-QD)

The temp/RH sensor requires minimal maintenance. Check monthly to make sure the radiation shield is free from debris. The filter at the end of the sensor should also be checked for contaminates. When installed in close proximity to the ocean or other bodies of salt water, a coating of salt may build up on the radiation shield, sensor, filter and even the RH chip. A buildup of salt on the filter or RH chip will delay or destroy the response to atmospheric humidity. The filter can be rinsed gently in distilled water. If necessary, the chip can be removed and rinsed as well. Do not scratch the RH chip while cleaning.

4.2.4 Calibration, Air Temperature and Relative Humidity (part #HMP45C-QD)

Recalibrate the temp/RH sensor annually. Obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for recalibration.

4.2.5 Troubleshooting, Air Temperature and Relative Humidity (part #HMP45C-QD)

Check the sensor cable. Disconnect the connector and look for damaged pins. Verify that the sensor body is connected to the sensor head. Under the filter assembly, verify the sensors are connected but not touching. Try connecting a substitute sensor. Obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for repair.

4.3 Rain Gage

4.3.1 General Description, Rain Gage (part #TE525-QD)

The Texas Electronics Rain Gage (part #TE525-QD) shown in Figure 4.3-1 is an adaptation of a Weather Bureau tipping bucket rain gage. The rain gage has a 6 inch collector. The rain gage sensor output has a switch closure for each bucket tip. Level the rain gage by adjusting the rain gage leveling screw. A post level and compass (part #16670) ship with the station.

FIGURE 4.3-1. Rain gage

4.3.2 Wiring, Rain Gage (part #TE525-QD)

The rain gage is connected to the RAWS connector panel "PRECIP" connector COLOR CODED BLUE. This sensor is internally wired from the RAWS connector panel to the CR1000 datalogger.

Connector Panel "PRECIP" connector COLOR CODED BLUE

Connector Pin A	Tipping Bucket	to CR1000	C6
Connector Pin B	5V	to CR1000	5V
Connector Pin C	Ground	to CR1000	Ground

4.3.3 Maintenance, Rain Gage (part #TE525-QD)

The rain gage funnel and bucket mechanism must be kept clean. Routinely check for and remove any foreign material, dust, insects, etc.

4.3.4 Calibration, Rain Gage (part #TE525-QD)

Recalibrate the rain gage annually. Obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for recalibration.

4.3.5 Troubleshooting, Rain Gage (part #TE525-QD)

Check the sensor cable. Disconnect the connector and use a DVM to check the resistance between Pin A (sensor signal) and Pin C (sensor ground). The resistance should read as an open circuit until you move the rain gage tipping mechanism where the magnet swings past the reed relay. Try connecting a substitute sensor. Obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for repair.

4.4 Solar Radiation

4.4.1 General Description, Pyranometer (part #CS300-QD)

The Apogee Pyranometer (part #CS300-QD) shown in Figure 4.4-1 measures incoming solar radiation with a silicon photovoltaic detector mounted in a cosine-corrected head. The detector outputs current; a shunt resistor in the sensor converts the signal from current to voltage. During the night the CS300-QD may read slightly negative incoming solar radiation. The negative signal is caused by RF noise.

FIGURE 4.4-1. Pyranometer

4.4.2 Wiring, Pyranometer (part #CS300-QD)

The pyranometer sensor is connected to the RAWS connector panel "SOLAR RAD SDI-12" connector COLOR CODED GREEN. The pyranometer sensor is internally wired from the RAWS connector panel to the CR1000 datalogger.

Connector Panel "SOLAR RAD SDI-12" connector COLOR CODED GREEN			
Connector Pin A	Solar Sensor +	to CR1000	3H
Connector Pin B	Solar Sensor -	to CR1000	3L/AG (3L shorted to AG)
Connector Pin C	Solar Sensor Gnd	to CR1000	AG
Connector Pin D	SDI-12 Ground	to CR1000	Ground*
Connector Pin E	SDI-12 Signal	to CR1000	C5* (*Note: 2nd SDI-12 sensor)
Connector Pin F	SDI-12 12V	to CR1000	12V*

4.4.3 Maintenance, Pyranometer (part #CS300-QD)

The pyranometer must be kept clean. Routinely check for and remove any foreign material, dust or debris on the sensor head. The debris can be removed with a blast of compressed air or with a soft bristle, camel hair brush. Handle the sensor carefully when cleaning. Be careful not to scratch the surface of the sensor.

4.4.4 Calibration, Pyranometer (part #CS300-QD)

Recalibrate the pyranometer annually. Obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for recalibration.

4.4.5 Troubleshooting, Pyranometer (part #CS300-QD)

Check the sensor cable. Disconnect the connector and use a DVM to check the voltage between Pin A Solar Sensor (+) and Pin B Solar Sensor (-). The voltage should be 0 to 200 mV for 0 to 1000 Wm^{-2} radiation. No voltage indicates a problem with either the photodiode or the shunt resistor, both of which are potted in the sensor head and cannot be serviced. Try connecting a substitute sensor. Obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for repair.

4.5 Wind Speed and Direction

4.5.1 Windset (part #034B-QD)

4.5.1.1 General Description, Windset (part #034B-QD)

The Met One Windset (part #034B-QD) shown in Figure 4.5-1 is an integrated cup anemometer and wind vane. The anemometer consists of three cups that sense the wind speed. These cups rotate on a vertical shaft that magnetically activates a sealed reed switch. The reed switch opens and closes at a rate proportional to wind speed. The wind direction is sensed by a vane. The vane drives a 10 K Ohm potentiometer. The wind speed sensor outputs a pulse. The wind direction sensor outputs a voltage.

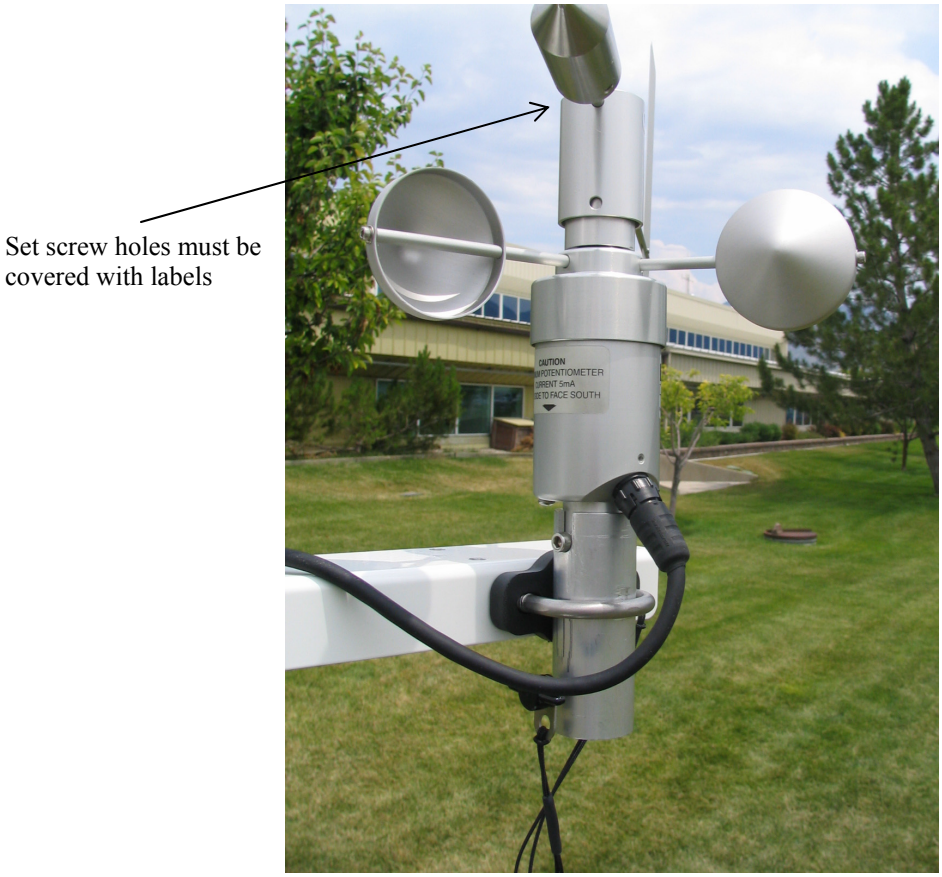


FIGURE 4.5-1. Windset

4.5.1.2 Wiring, Windset (part #034B-QD)

The windset sensor is connected to the RAWS connector panel "WS/WD" connector COLOR CODED RED. The wind speed probe is internally wired from the RAWS connector panel to the CR1000 datalogger.

Connector Panel "WS/WD" connector COLOR CODED RED

Connector Pin A	Sensor ground	to CR1000	AG
Connector Pin B	Wind dir. Excitation	to CR1000	Ex2
Connector Pin C	Wind dir. Signal	to CR1000	2H
Connector Pin D	Power ground	to CR1000	Ground
Connector Pin E	+12V power	to CR1000	+12V
Connector Pin F	Wind speed signal	to CR1000	P1

4.5.1.3 Maintenance, Windset (part #034B-QD)

The wind vane tail must be attached to the hub. Maintain the tail assembly with the tail vertical. Extra labels are included with the 034B-QD to recover the holes if the sensor has to be disassembled for maintenance. The set screw holes must be covered with these labels to prevent corrosion and assure the warranty. Verify free movement of the cup anemometer and wind vane.

4.5.1.4 Calibration, Windset (part #034B-QD)

Recalibrate the windset (part #034B-QD) annually. Obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for recalibration.

4.5.1.5 Troubleshooting, Windset (part #034B-QD)

Check the sensor cable. Disconnect the connector and look for damaged pins. Verify free movement of the cup anemometer and wind vane. Try connecting a substitute sensor. Obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for repair.

4.5.2 2-D WindSonic (part #WindSonic-QD) (optional)

4.5.2.1 General Description, 2-D WindSonic (part #WindSonic-QD)

The Gill Instruments 2-D Sonic Wind Sensor (part #WindSonic-QD) shown in Figure 4.5-2 is an ultrasonic anemometer for measuring wind direction and wind speed. It uses two pairs of orthogonally oriented transducers to sense the horizontal wind. The transducers bounce the ultrasonic signal from a hood, thus minimizing the effects of transducer shadowing and flow distortion. The 2-D Sonic Wind Sensor makes wind measurements at a frequency of 1 Hz and outputs a SDI-12 signal to the datalogger.

FIGURE 4.5-2. 2-D WindSonic

4.5.2.2 Wiring, 2-D WindSonic (part #WindSonic-QD)

The 2-D Sonic Wind Sensor is connected to the RAWS connector panel "SDI-12" connector COLOR CODED YELLOW. The wind sensor is internally wired from the RAWS connector panel to the CR1000 datalogger.

Connector Panel "SDI-12" connector COLOR CODED YELLOW			
Connector Pin A	Signal +	to CR1000	C7
Connector Pin B	12V	to CR1000	12V
Connector Pin C	Power ground	to CR1000	Ground
Connector Pin D	Open	to CR1000	

4.5.2.3 Maintenance, 2-D WindSonic (part #WindSonic-QD)

There are no user-serviceable parts on the 2-D Sonic Wind Sensor. Keep the transducer paths clear of any obstructions. When clearing the transducer paths, do not remove the "rubber" caps on each of the transducers.

4.5.2.4 Calibration, 2-D WindSonic (part #WindSonic-QD)

Recalibrate the 2-D Sonic Wind Sensor annually. Obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for recalibration.

4.5.2.5 Troubleshooting, 2-D WindSonic (part #WindSonic-QD)

Check the sensor cable. Disconnect the connector and look for damaged pins. Try connecting a substitute sensor. Should the 2-D sonic sensor be damaged, fails to output data, or sends a nonzero diagnostic, obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for repair.

4.6 Barometric Pressure (optional)

4.6.1 General Description, Barometric Pressure (part #CS100)

The Setra Barometric Pressure Sensor (part #CS100) shown in Figure 4.6-1 is a capacitive pressure transducer that uses Setra's electrical capacitor technology for barometric pressure measurements over the 600 to 1100 milibar range. The CS100 is supplied in the triggered mode, in which the datalogger switches 12 VDC power to the barometer before the measurement. The datalogger then powers down the barometer after the measurement to conserve power.

FIGURE 4.6-1. Barometric pressure

4.6.2 Wiring, Barometric Pressure (part #CS100)

The barometric pressure sensor (part #CS100) is mounted inside the RAWS environmental enclosure and the sensor wires are attached to the CR1000 printed circuit board wiring panel.

CS100 Barometric Pressure Sensor wires attached to CR1000 Wiring Panel

CS100 Blue wire	to CR1000 wiring panel	5H
CS100 Yellow wire	to CR1000 wiring panel	AG
CS100 Red wire	to CR1000 wiring panel	12V
CS100 Clear wire	to CR1000 wiring panel	Ground
CS100 Black wire	to CR1000 wiring panel	Ground
CS100 Green wire	to CR1000 wiring panel	C4

4.6.3 Maintenance, Barometric Pressure (part #CS100)

Since the sensor is semi-sealed, minimum maintenance is required. Change the RAWS enclosure desiccant regularly; failure to protect the CS100 sensor from condensation may result in permanent damage.

CAUTION The CS100 is sensitive to static when the back plate is removed. To avoid damage, take adequate anti-static measures when handling this sensor.

4.6.4 Calibration, Barometric Pressure (part #CS100)

Recalibrate the CS100 Barometric Pressure Sensor annually. Obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for recalibration.

4.6.5 Troubleshooting, Barometric Pressure (part #CS100)

Verify the sensor wires are securely fastened to the CS100 Barometric Pressure Sensor connector and the CR1000 printed circuit board wiring panel. Use a DVM to check the sensor output voltage on the CR1000 printed circuit board wiring panel (0 to 2.5 VDC) between terminals 5H and AG.

NOTE For the DVM test, "temporarily" move the green wire from "C4" to "5V" terminal. No voltage indicates a problem with the sensor or a bad sensor cable connection. Try connecting a substitute sensor.

Obtain a Return Material Authorization (RMA) number before returning this sensor to Campbell Scientific for repair.

4.7 Fuel Moisture and Fuel Temperature (optional)

4.7.1 General Description, Fuel Moisture/Fuel Temperature (part #CS515-QD)

The Campbell Scientific Fuel Moisture/Fuel Temperature Sensor (part #CS515-QD) shown in Figure 4.7-1 consists of a CS505 Fuel Moisture Probe, CS205 Fuel Temperature Stick, and 107-QD thermistor mounted on a 10974 fuel moisture/temperature mounting stake. The fuel moisture probe provides

the moisture content of a standard 10-hour fuel moisture dowel. This moisture represents the moisture content of small-diameter (10-hour time lag) forest fuels. The fuel temperature probe consists of a Ponderosa pine dowel with a bored hole and a Model 107 Temperature Probe inserted into the dowel. The CS205 mounts on the mounting stake with the CS505.

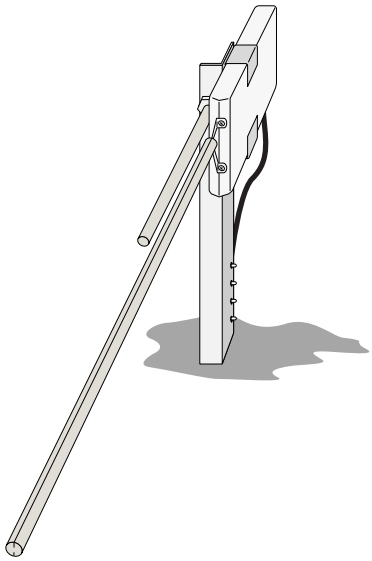


FIGURE 4.7-1. CS515-QD Fuel Moisture/Fuel Temperature

4.7.2 Wiring, Fuel Moisture/Fuel Temperature (part #CS515-QD)

The Campbell Scientific CS505/CS205-QD sensor is connected to the RAWS connector panel "FM/FT" connector COLOR CODED BROWN.

Connector Panel "FM/FT" connector COLOR CODED BROWN			
Connector Pin A	CS205 Temp. Signal	to CR1000	4L
Connector Pin B	Sensor Ground	to CR1000	Ground
Connector Pin C	CS205 Temp. Excitation	to CR1000	EX1
Connector Pin D	CS505 FM Enable	to CR1000	C8
Connector Pin E	CS505 FM Signal	to CR1000	4H
Connector Pin F	CS505 FM +12V power	to CR1000	+12V

4.7.3 Maintenance, Fuel Moisture/Fuel Temperature (part #CS515-QD)

The CS505 Fuel Moisture dowel/element should be changed at least once a year with a new element in the spring. Since the characteristics of wood change so rapidly, more frequent replacements may be desirable. To change the sensor element, loosen the Phillips head screws and replace with a new element. Tighten the screws after replacing the element.

The CS205 consists of a 107 Temperature Probe and fuel moisture stick. The CS205 Fuel Moisture Stick should be changed annually or more frequently as required. The wood should visually appear fresh and new, not gray or discolored. The CS205 inserts into the compression fitting so that compression is applied to the split end of the stick gripping the 107 temperature probe.

4.7.4 Calibration, Fuel Moisture/Fuel Temperature (part #CS515-QD)

For most applications it is unnecessary to calibrate the CS515-QD Fuel Moisture and Fuel Temperature Sensor. However, for those users that are interested in calibrating this sensor, please contact a Campbell Scientific Applications Engineer.

4.7.5 Troubleshooting, Fuel Moisture/Fuel Temperature (part #CS515-QD)

Check the sensor cable. Disconnect the connector and look for damaged pins. Verify the CS505 sensor element is securely fastened. Try connecting a substitute sensor. Obtain a Return Material Authorization (RMA) number before returning the CS515-QD sensor to Campbell Scientific for repair.

5. Equipment Maintenance, Calibration, and Troubleshooting

5.1 Solar Panels (part #SP10/20-QD)

5.1.1 General Description, Solar Panel (part #SP10/20-QD)

The RAWS Solar Panel is a photovoltaic power source used for charging lead acid batteries. The SP20-QD 20 watt solar panel is used for system configurations that have higher-than-average power requirements. It is also recommended for use at higher elevations and latitudes. The solar panel should be mounted facing south if located in the northern hemisphere, or facing north in the southern hemisphere.

The SP10-QD 10 watt solar panel is recommended for a RAWS Quick Deployment Weather Station where NO communication equipment is used. The SP20-QD 20 watt solar panel is recommended for a RAWS Quick Deployment Weather Station where communication equipment is used (i.e., GOES, voice, cell phone, or radio).

NOTE The solar panel selected for the RAWS Quick Deployment Weather Station depends on the station power requirements, specifically the communication equipment selected for the station.

The SP10-QD solar panel outputs 0.59 Amps, 8.9 Watts typical peak power.

The SP20-QD solar panel outputs 1.17 Amps, 18 Watts typical peak power.

5.1.2 Wiring, Solar Panel (part #SP10/20-QD)

The RAWS-Solar Panel (part # SP20-QD or SP10-QD) attaches to the connector panel labeled “BATT CHARGER/SOLAR PANEL”. Inside the RAWS environmental enclosure the “BATT CHARGER/SOLAR PANEL” connector pin A and pin B are wired to the CH100 charger/regulator “CHG” and “CHG” ports. Polarity does not matter; either lead can be connected to either terminal. The CH100 charger/regulator has two functions: 1) blocks any current flow from the battery to the solar panel, and 2) limits the source current to the battery.

5.1.3 Maintenance, Solar Panel (part #SP10/20-QD)

An occasional cleaning of the glass improves the solar panel's efficiency.

5.1.4 Calibration, Solar Panel (part #SP10/20-QD)

No calibration is required.

5.1.5 Troubleshooting, Solar Panel (part #SP10/20-QD)

If a problem with the solar panel is suspected, the solar panel may be checked by measuring the voltage output from the solar panel. Check the voltage with a voltmeter connected between the two leads going to the CH100 charger/regulator "CHG" "CHG" terminals located inside the environmental enclosure (15 VDC to 28 VDC). There must be solar radiation incident on the panel and there must be a load connected to the solar panel. The load can be the datalogger, other equipment, or a 75 ohm resistor capable of dissipating solar panel power between the two leads. No voltage output implies a bad solar panel, regulator, or cable. The magnitude of the voltage output depends on the incident solar radiation. Check the sensor cable. Disconnect the connector and look for damaged pins. Try connecting a substitute panel. Obtain a Return Material Authorization (RMA) number before returning the SP10/20-QD to Campbell Scientific for repair.

5.2 Charger/Regulator

5.2.1 General Description, 12 V Charger/Regulator (part #CH100)

The 12 Volt charger/regulator (part #CH100) is a charging regulator for 12 V rechargeable batteries. The CH100 is connected to an external charging source such as an unregulated solar panel (part # SP20-QD or SP10-QD) or a wall charger (part #9591-QD). The CH100 charger/regulator has two functions: 1) blocks any current flow from the battery to the solar panel, and 2) limits the source current to the battery.

FIGURE 5.2-1. 12-volt charger/regulator

5.2.2 Wiring, 12 V Charger/Regulator (part #CH100)

The leads from the RAWS connector panel "BATT CHARGER/SOLAR PANEL" connector COLOR CODED PURPLE are wired to the CH100 "CHG" terminals. Polarity does not matter; either lead can be connected to either terminal. The charge indicating diode should be "ON" when voltage to the charging circuitry (CHG Terminals) is present.

An internal and/or external battery can be connected to the CH100 Charger/Regulator by means of the INT (Internal) or EXT (External) connectors. The battery red lead connects to the positive battery terminal and the black lead connects to the negative terminal.

NOTE An "external battery cable" (part #6186) ships with the RAWS Quick Deployment Weather Station.

Connect 12 V power to the datalogger and/or peripherals using the "+12 and Ground" terminals. The ON-OFF switch applies power to these 12 V terminals.

WARNING **Reversal of battery polarity will damage the CH100 or battery.**

CAUTION A battery must be attached for the CH100 to function correctly as a power supply.

CAUTION It is possible to leave two batteries connected. The battery connections are diode isolated; however, if one of the batteries fails, it could draw all the charging current and the other battery will be discharged.

5.2.3 Maintenance, 12 V Charger/Regulator (part #CH100)

There are no user-serviceable parts on the CH100. No maintenance is required.

5.2.4 Calibration, 12 V Charger/Regulator (part #CH100)

No calibration is required.

5.2.5 Troubleshooting, 12 V Charger/Regulator (part #CH100)

If a problem with the charger/regulator (part #CH100) is suspected, the CH100 may be checked by measuring: 1) input voltage (CHG terminals) from the solar panel (15 VDC to 28 VDC) or input voltage from the AC adapter (part #9591-QD) about 18 VAC RMS, 2) charging output voltage (BATT INT or EXT terminal) with battery disconnected about 13.5 VDC to 14 VDC, and 3) power out (+12 terminals) about 11 VDC to 14 VDC. No voltage output implies a bad solar panel, regulator, or battery. Power out (+12 terminals) is controlled by the CH100 ON-OFF switch position. If problems persist, try a substitute. Obtain a Return Material Authorization (RMA) number before returning this equipment to Campbell Scientific for repair.

NOTE Power out (+12 terminals) is controlled by the CH100 ON-OFF switch position.

5.3 Battery

5.3.1 General Description, Battery (part #BP24-QD or BP7-QD)

The RAWS battery (part #BP24-QD or BP7-QD) are rechargeable 12 Volt batteries. The battery requires a regulated charging source provided by the RAWS Charger/Regulator (part #CH100) connected to an unregulated solar panel or a wall charger.

WARNING **RAWS rechargeable batteries are designed to be float charged. Permanent damage occurs and battery life is shortened if the battery is allowed to discharge below 10.5 volts.**

5.3.2 Wiring, Battery

The RAWS rechargeable battery should be connected to the CH100 charger/regulator INT (Internal) connector. The battery red lead connects to the positive battery terminal and the black lead connects to the negative terminal. If desired, an external battery can be connected to the CH100 charger/regulator EXT (External) connector. It is possible to leave two batteries connected. The battery connections are diode isolated; however, if one of the batteries fails, it could draw all the charging current and the other battery will be discharged. An "external battery cable" (part #6186) ships with the RAWS Quick Deployment Weather Station.

WARNING **Reversal of battery polarity will damage the CH100 or battery.**

CAUTION It is possible to leave two batteries connected. The battery connections are diode isolated; however, if one of the batteries fails, it could draw all the charging current and the other battery will be discharged.

5.3.3 Maintenance, Battery

There are no user-serviceable parts on the battery. No maintenance is required.

5.3.4 Calibration, Battery

No calibration is required.

5.3.5 Troubleshooting, Battery

Measure the +12 V and Ground terminal on the CR1000 printed circuit board wiring panel. Acceptable readings are +11 VDC to +14 VDC. Use PC200W software to collect the 1-HR data table from the CR1000 datalogger and review the historical record of battery voltage.

5.4 GOES Transmitter (part #TX312) (Optional)

5.4.1 General Description, GOES Transmitter (part #TX312)

The High Data Rate GOES transmitter (part #TX312) shown in Figure 5.4-1 supports one-way communication, via satellite, from a Campbell Scientific datalogger to a ground receiving station. Satellite telemetry offers a convenient communication alternative for field stations where phone systems or RF systems are impractical or rendered unreliable after a tragedy to the local infrastructure. Data transmission rates of 100, 300, and 1200 bps are supported. Because clock accuracy is critically important for GOES satellite telemetry, the TX312 includes a robust, TCXO-based real-time clock and a GPS receiver.

The TX312 transmitter has two siting requirements for proper operation. The GOES antenna must have a clear view of the spacecraft. The GOES antenna is directional and should be aimed at the spacecraft. Both elevation and azimuth are unique to the location of the planet and must be set. A poorly aimed antenna will cause a drop in signal strength or possibly prevent successful transmission.

For more information on the GOES transmitter (part #TX312) and antenna siting, go to our website at www.campbellsci.com, enter the "TX312" in the "Search" box on the website mentioned above, and go the equipment manual. The GOES transmitter (part #TX312) manual is also provided on the Resource CD which ships with the RAWS Quick Deployment Weather Station.

NOTE The spacecraft specific DCP-Setup parameters for the GOES transmitter must be entered in the CR1000KD menus for the GOES transmitter TX312 to work properly. If the RAWS Quick Deployment Weather Station does NOT have a GOES transmitter disregard the DCP-Setup parameters.

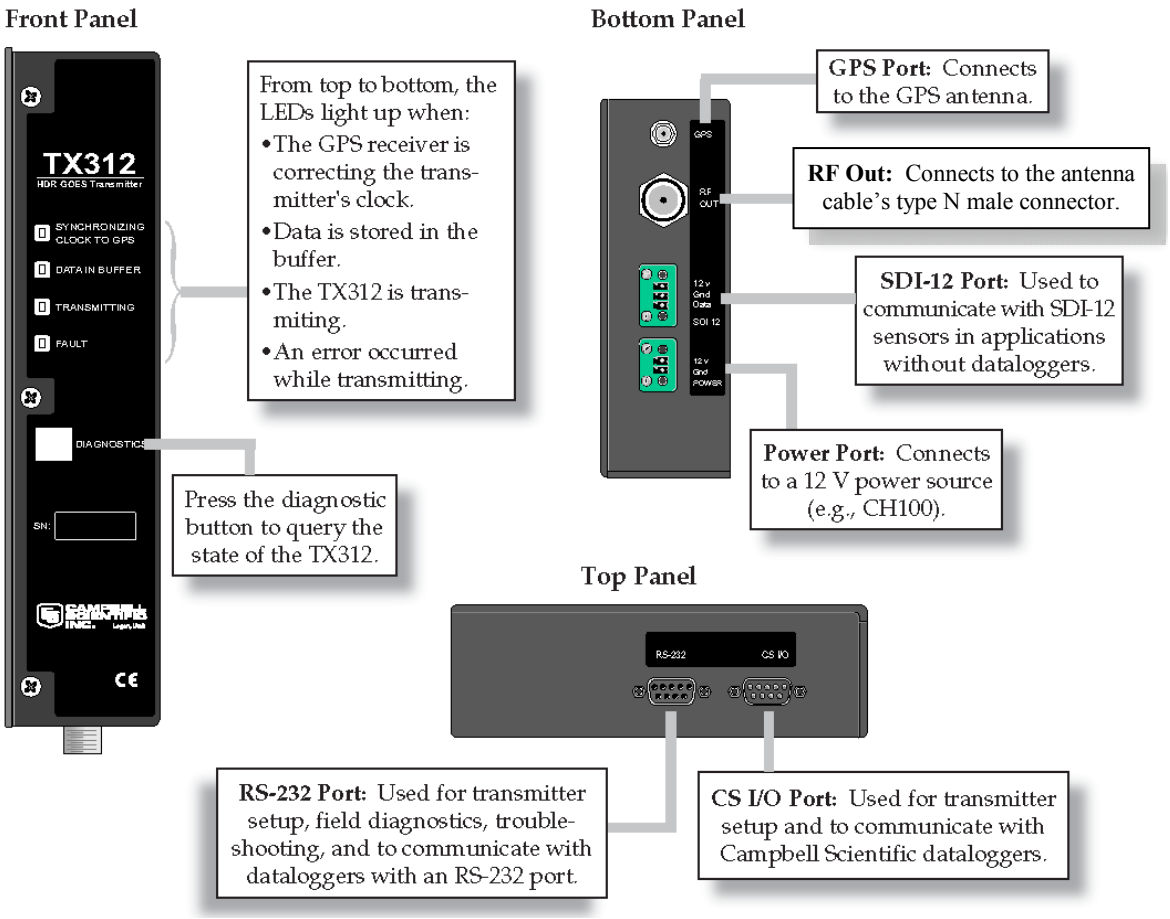

Front Panel
TX312
HDR GOES Transmitter
SYNCHRONIZING CLOCK TO GPS
DATA IN BUFFER
TRANSMITTING
FAULT
DIAGNOSTICS
SN:
From top to bottom, the LEDs light up when:
•The GPS receiver is correcting the transmitter's clock.
•Data is stored in the buffer.
•The TX312 is transmiting.
•An error occurred while transmitting.
Press the diagnostic button to query the state of the TX312.
Bottom Panel
GPS
RF OUT
12 v Gnd Data
SDI 12
12 v Gnd POWER
GPS Port: Connects to the GPS antenna.
RF Out: Connects to the antenna cable's type N male connector.
SDI-12 Port: Used to communicate with SDI-12 sensors in applications without dataloggers.
Power Port: Connects to a 12 V power source (e.g., CH100).
Top Panel
RS-232
CS I/O
RS-232 Port: Used for transmitter setup, field diagnostics, troubleshooting, and to communicate with dataloggers with an RS-232 port.
CS I/O Port: Used for transmitter setup and to communicate with Campbell Scientific dataloggers.

FIGURE 5.4-1. GOES transmitter

5.4.2 Wiring, GOES Transmitter (part #TX312)

The GOES transmitter (part #TX312) is mounted inside the RAWS environmental enclosure and the transmitter connections are described below;

GOES Transmitter TX312 Connection inside the RAWS environmental enclosure

GOES	TX312 "CS I/O" Port	--to-- CR1000 PC Board "CS I/O" Port using a *SC12 Cable
GOES	TX312 "GPS Port"	--to-- GPS Antenna Cable
GOES	TX312 "RF Out"	--to-- GOES Antenna Cable
GOES	TX312 "Power Port"	--to-- Battery Cable Junction Connector

*Note: The SC12 Cable ships with the RAWS Quick Deployment Weather Station.

5.4.3 Maintenance, GOES Transmitter (part #TX312)

There are no user-serviceable parts on the GOES transmitter. No maintenance is required.

5.4.4 Calibration, GOES Transmitter (part #TX312)

No calibration is required.

5.4.5 Troubleshooting, GOES Transmitter (part #TX312)

If a problem with the GOES transmitter (part #TX312) is suspected, the TX312 may be checked by measuring the +12 V and Ground terminal on the CR1000 PC-board wiring panel. Acceptable readings are +11 VDC to +14 VDC. Check the SC12 cable connection between the CR1000 wiring panel and the TX312. Press the TX312 diagnostic button to query the state of the transmitter. If problems persist, try a substitute. Obtain a Return Material Authorization (RMA) number before returning this equipment to Campbell Scientific for repair.

5.5 Voice Radio Interface (part #VSP3) (Optional)

5.5.1 General Description, Voice Radio Interface (part #VSP3)

The DACOM Voice Radio Interface (part #VSP3) shown in Figure 5.5-1 is mounted inside the RAWS environmental enclosure. The VSP3 converts data into voice messages that can be transmitted via UHF or VHF transceiver. The VSP3 Vosponder uses phonetic native text string to speech conversion, which provides for an unlimited vocabulary. The Vosponder communicates with a datalogger using the SDI-12 protocol. The VSP3 Vosponder can be integrated into an existing UHF/VHF radio network. A minimum of two radios with matching frequencies is required. The VSP3 ships preprogrammed with a voice image file for the fire weather market.

NOTE A minimum of two radios with matching frequencies is required to transmit voice messages. To activate the voice file, hold down the radio microphone button and press 9 on the radio keypad. Radios can be purchased from Campbell Scientific.

FIGURE 5.5-1. Voice radio interface

5.5.2 Wiring, Voice Radio Interface (part #VSP3)

The Voice Radio Interface (part #VSP3) is mounted inside the RAWS environmental enclosure and the VSP3 connections are described below.

Voice Radio Interface (part #VSP3) inside the RAWS environmental enclosure

VSP3 "Ground" terminal contact --to-- CR1000 PC Board "G"
VSP3 "+12V" terminal contact --to-- CR1000 PC Board "+12V"
VSP3 "DATA" terminal contact --to-- CR1000 PC Board "C1"
VSP3 "RADIO" RJ45 Connector --to-- UHF/VHF Radio*
*Note: Maxon and Bendix King Radio cables are available from Campbell Scientific.

5.5.3 Maintenance, Voice Radio Interface (part #VSP3)

There are no user-serviceable parts on the VSP3. No maintenance is required.

5.5.4 Calibration, Voice Radio Interface (part #VSP3)

No calibration is required.

5.5.5 Troubleshooting, Voice Radio Interface (part #VSP3)

If a problem with the voice radio interface (part #VSP3) is suspected, the VSP3 may be checked by measuring the +12 V and Ground terminal on the VSP3. Acceptable readings are +11 VDC to +14 VDC. Verify the sensor wires are securely fastened to the VSP3 connector and the CR1000 printed circuit board wiring panel. If problems persist, try a substitute. Obtain a Return Material Authorization (RMA) number before returning this equipment to Campbell Scientific for repair.

5.6 CR1000 Keyboard/Display (part #CR1000KD)

5.6.1 General Description, CR1000 Keyboard/Display (part #CR1000KD)

The CR1000 Keyboard/Display (part #CR1000KD) shown in Figure 5.6-1 is used to check datalogger status, display or plot sensor readings and stored values, and to enter numeric data or change port/flag state. The CR1000KD is powered from the CR1000 printed circuit board "CS I/O" connector via our 9-Pin CS I/O serial cable (part #10873) that ships with the RAWS station.

NOTE Use the CR1000KD menus to enter GOES DCP-Setup Parameters and to select the wind speed/direction sensor on the RAWS station. If the RAWS Quick Deployment Weather Station does NOT have a GOES transmitter, disregard the DCP-Setup parameters.

FIGURE 5.6-1. CR1000 Keyboard/Display

5.6.2 Wiring, CR1000 Keyboard/Display (part #CR1000KD)

The CR1000 Keyboard/Display (part #CR1000KD) connects to the CR1000 PC board "CS I/O" 9-Pin connector using our CS I/O serial cable (part #10873) that ships with the RAWS station.

5.6.3 Maintenance, CR1000 Keyboard/Display (part #CR1000KD)

There are no user-serviceable parts on the CR1000KD. No maintenance is required.

5.6.4 Calibration, CR1000 Keyboard/Display (part #CR1000KD)

No calibration is required.

5.6.5 Troubleshooting, CR1000 Keyboard/Display (part #CR1000KD)

If a problem with the CR1000 Keyboard/Display is suspected, the CR1000KD may be checked by connecting the CR1000KD to the CR1000 PC board 9-Pin "CS I/O" connector using our CS I/O serial cable (part #10873). The CR1000KD display should be visible. Check the CH100 on/off switch. If the display is not visible, check the CR1000 wiring panel for 12 Volt power. If the CR1000 is unresponsive to CR1000KD key strokes, then there might be a problem with the CR1000 datalogger. If problems persist, try a substitute. Obtain a Return Material Authorization (RMA) number before returning this equipment to Campbell Scientific for repair.

5.7 CR1000 Datalogger (part #CR1000)

5.7.1 General Description, CR1000 Datalogger (part #CR1000)

The CR1000 shown in Figure 5.7-1 provides sensor measurement, timekeeping, data reduction, data/program storage and control functions. The RAWS Quick Deployment CR1000 datalogger

includes 4 MB of memory for data and program storage. A lithium battery backs up the RAM and real-time clock. The CR1000 also suspends execution when primary power drops below 9.6 V, reducing the possibility of inaccurate measurements.

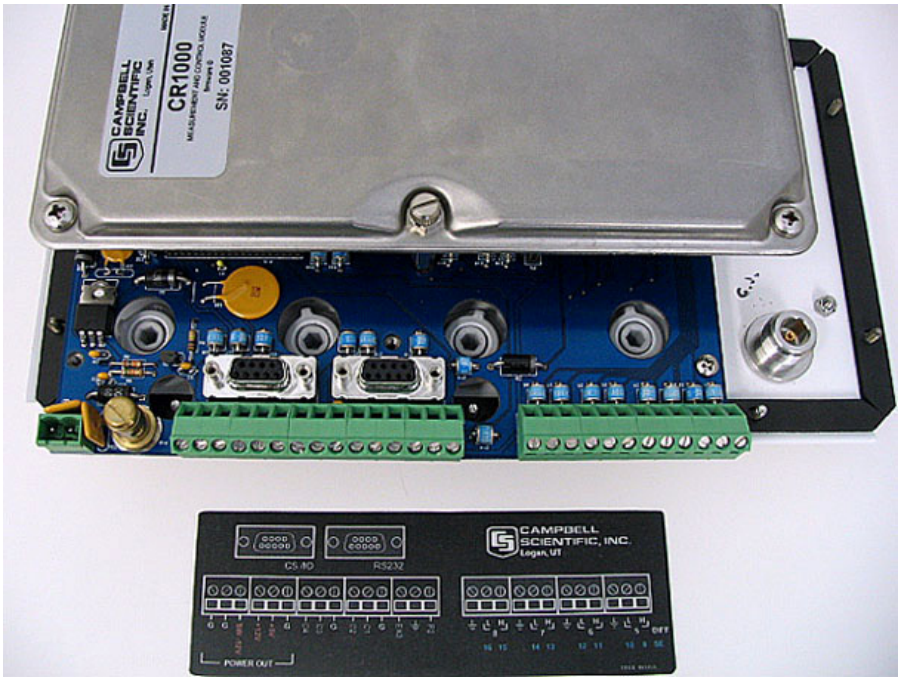


FIGURE 5.7-1. CR1000 and printed circuit wiring panel

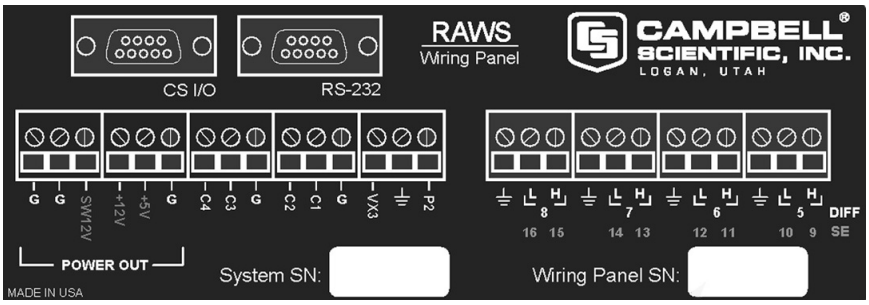


FIGURE 5.7-2. Printed circuit board wiring panel connector ID

5.7.2 Wiring, CR1000 Datalogger (part #CR1000)

The CR1000 datalogger is mounted inside the RAWS environmental enclosure and fastened to the CR1000 printed circuit board wiring panel. Connect 12 V power to the CR1000 printed circuit board wiring panel green power connector. The CH100 ON-OFF switch applies power to the 12 V terminals.

5.7.3 Maintenance, CR1000 Datalogger (part #CR1000)

There are no user-serviceable parts on the CR1000. No maintenance is required.

5.7.4 Calibration, CR1000 Datalogger (part #CR1000)

Recalibrate the CR1000 datalogger every two years. Obtain a Return Material Authorization (RMA) number before returning the CR1000 to Campbell Scientific for recalibration.

5.7.5 Troubleshooting, CR1000 Datalogger (part #CR1000)

If a problem with the CR1000 datalogger is suspected, the CR1000 may be checked by connecting the CR1000KD to the CR1000 printed circuit board 9-Pin "CS I/O" connector using our CS I/O serial cable (part #10873). The CR1000KD display should be visible. If the display is not visible, check the CR1000 printed circuit board for 12 Volt power. If the CR1000 is unresponsive to CR1000KD key strokes, then there might be a problem with the CR1000 datalogger. If problems persist, try a substitute. Contact a Campbell Scientific applications engineer for assistance. Obtain a Return Material Authorization (RMA) number before returning this equipment to Campbell Scientific for repair.

6. Desiccant

6.1 When to Replace Desiccant

A humidity indicator card and desiccant packs are provided with the weather station. Place the humidity indicator card and 2 ea. desiccant packs inside the enclosure. Desiccant packets inside the enclosure should be replaced with fresh packets when the upper dot on the indicator begins to turn pink. The indicator tab does not need to be replaced unless the colored circles overrun. A humidity indicator card (part #6571) and desiccant pack (part # 4905) may be ordered through Campbell Scientific. Desiccant packs inside of the datalogger do not require replacement under normal conditions.

6.2 Reusing Desiccant

Customers can reactivate saturated desiccant packets. Care must be taken. If the heating process is too rapid, water vapor is released too quickly causing too much pressure to build up inside the packets so that the packets burst.

Standard Oven Method:

1. Bake at an oven temperature of 125ºF for 2 hours.
2. Increase the oven temperature to 175ºF and bake for 2 hours.
3. Increase the oven temperature to 245ºF to 250ºF and bake for 12 hours.

The optimum situation for reactivation is to use a recalculating oven that has a ramping temperature. The desiccant should bake for 16 hours, and the final temperature should be 245ºF to 250ºF.

7. Items that Ship with RAWS Station

The RAWS Quick Deployment Weather Station ships with the following items:

1 ea. RAWS-F manual
1 ea. keyboard/display, part # CR1000KD
1 ea. RS-232 cable, part #10873
1 ea. external battery cable, part #6186
1 ea. flat blade screwdriver, overall length 6.90 inch, part #1113
1 ea. Phillips screwdriver, overall length 9.00 inch, part #18903
1 ea. UV-resistant cable tie kit, part #7364
1 ea. enclosure conduit cable entry adapter, part #s 5629, 5631, 4265
3 ea. tripod stakes, part #17049
1 ea. grounding wire, part #2833
1 ea. grounding wire clamp, part #1013
1 ea. packet with compass and post level, part #16770
1 ea. RAWS Wind Sensor alignment tool #18906
1 ea. "ResourceCD" reference material and starter software, part #16478
1 ea. enclosure supply kit #7363. Note: the contents of the kit are enclosed in a resealable bag to protect the desiccant packs and humidity indicator from water vapor.
- 4 ea. #4905 desiccant packs
- 1 ea. #6571 humidity indicator
- 6 ea. #2207 4-inch cable ties
- 6 ea. #4005 8-inch cable ties
- 4 ea. #2376 wire tie tabs
- 1 ea. #6596 4 oz. putty for sealing the enclosure conduit
- 8 ea. #505 screws
- 8 ea. #6044 grommets for attaching peripherals to the enclosure's back plate
- 1 ea. #6290 Philips screwdriver

8. References

8.1 Specifications, Equipment and Sensor

Specifications are available from our web site at http://www.campbellsci.com/index.cfm.

For "sensors specifications," click on "Products", select "Sensors" and go to the sensor manual for specifications. For "equipment specifications", enter the part # in the "Search" box on the website mentioned above and go to the equipment manual for specifications.

NOTE Equipment and sensor specifications are provided on the Resource CD which ships with the RAWS Quick Deployment Weather Station.

8.2 Siting References

General guidelines for site selection are listed below.

EPA, (1987): *On-Site Meteorological Program Guidance for Regulatory Modeling Applications*, EPA-450/4-87-013, Office of Air Quality Planning and Standards, Research Triangle Park, NC, 27711.

WMO, (1983): *Guide to Meteorological Instruments and Methods of Observation*, World Meteorological Organization, No. 8, 5th edition, Geneva, Switzerland.

The State Climatologist, (1985): *Publication of the American Association of State Climatologists: Height and Exposure Standards, for Sensors on Automated Weather Stations*, vol. 9, No. 4.

EPA, (1989): *Quality Assurance Handbook for Air Pollution Measurement Systems*, EPA Office of Research and Development, Research Triangle Park, North Carolina 27711.

8.3 RAWS Orientation

8.3.1 Determining True North and Sensor Orientation

Orientation of the wind direction sensor is done after the datalogger has been programmed and the location of True North has been determined. True North is usually found by reading a magnetic compass and applying the site-specific correction for magnetic declination; where the magnetic declination is the number of degrees between True North and Magnetic North. Magnetic declination for a specific site can be obtained from a USGS map, local airport, or through the web calculator offered by the USGS (Section 8.3.2). A general map showing magnetic declination for the contiguous United States is shown in Figure 8.3-1.

Declination angles are always subtracted from the compass reading to find True North. A declination angle east of True North is reported as positive a value and is subtracted from 360 (0) degrees to find True North as shown Figure 8.3-2. A declination angle west of True North is reported as a negative value and is also subtracted from 0 (360) degrees to find True North as shown in Figure 8.3-3. Note that when a negative number is subtracted from a positive number, the resulting arithmetic operation is addition.

For example, the declination for Longmont, CO is 10.1°, thus True North is 360° - 10.1°, or 349.9° as read on a compass. Likewise, the declination for Mc Henry, IL is -2.6°, and True North is 0° - (-2.6°), or 2.6° as read on a compass.

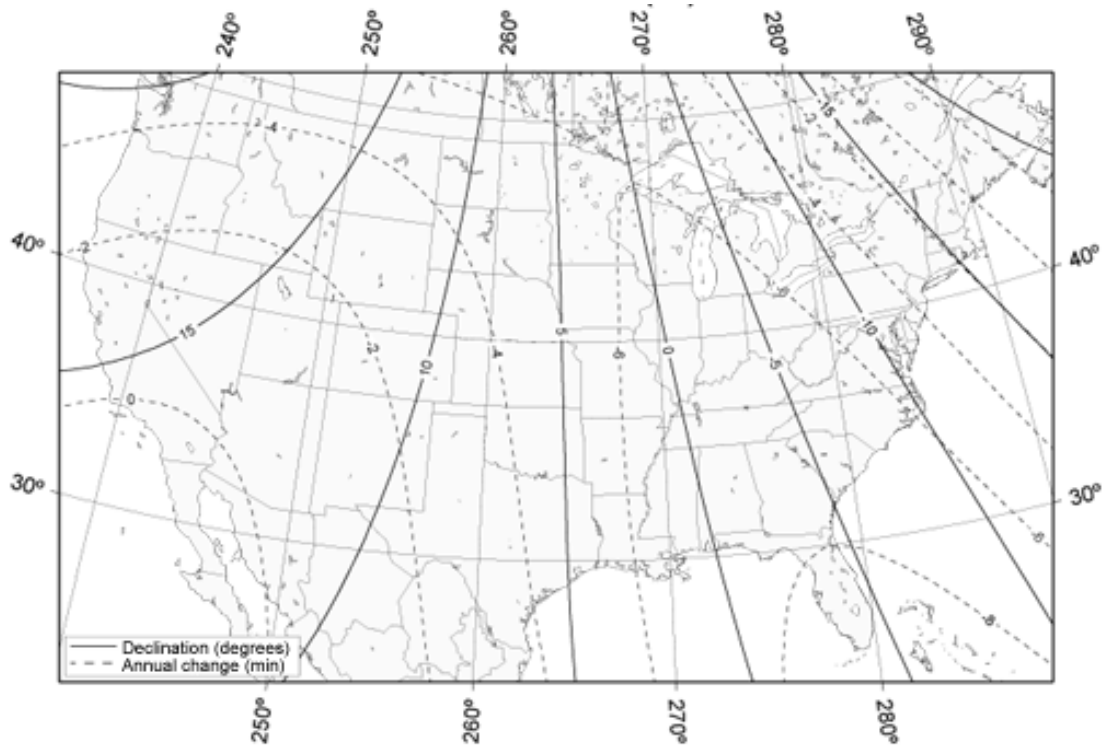


FIGURE 8.3-1. Magnetic declination for the contiguous United States

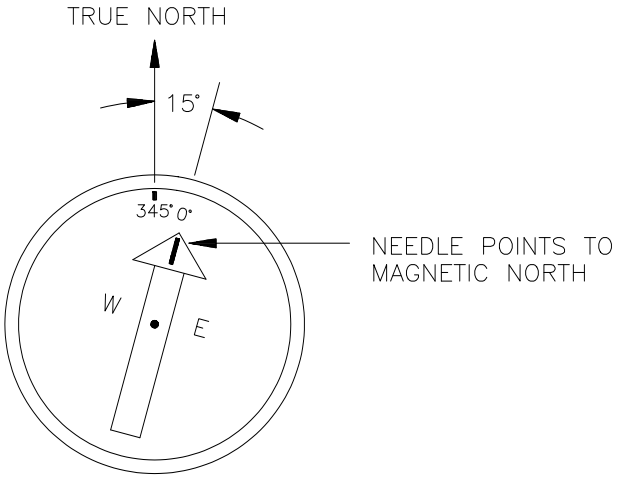


FIGURE 8.3-2. A declination angle east of True North (positive) is subtracted from 360 (0) degrees to find True North

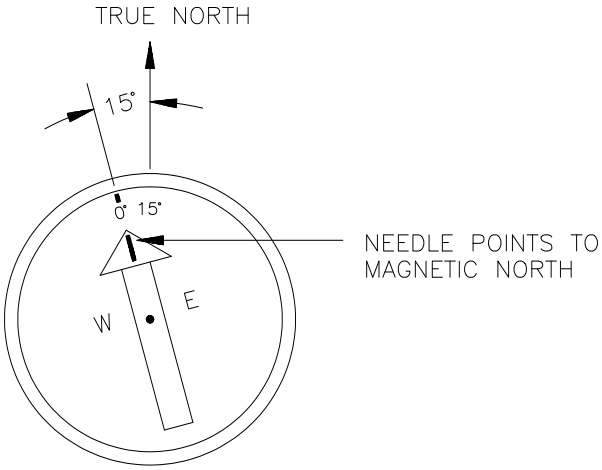


FIGURE 8.3-3. A declination angle west of True North (negative) is subtracted from 0 (360) degrees to find True North

8.3.2 USGS Web Calculator

The USGS provides an easy way of determining declination of a specific site. Since magnetic declination fluctuates with time, it should be adjusted each time the wind sensor orientation is adjusted. The calculator can be accessed at: www.ngdc.noaa.gov/geomagmodels/Declination.jsp. Figure 8.3-4 shows an example for Logan, UT.

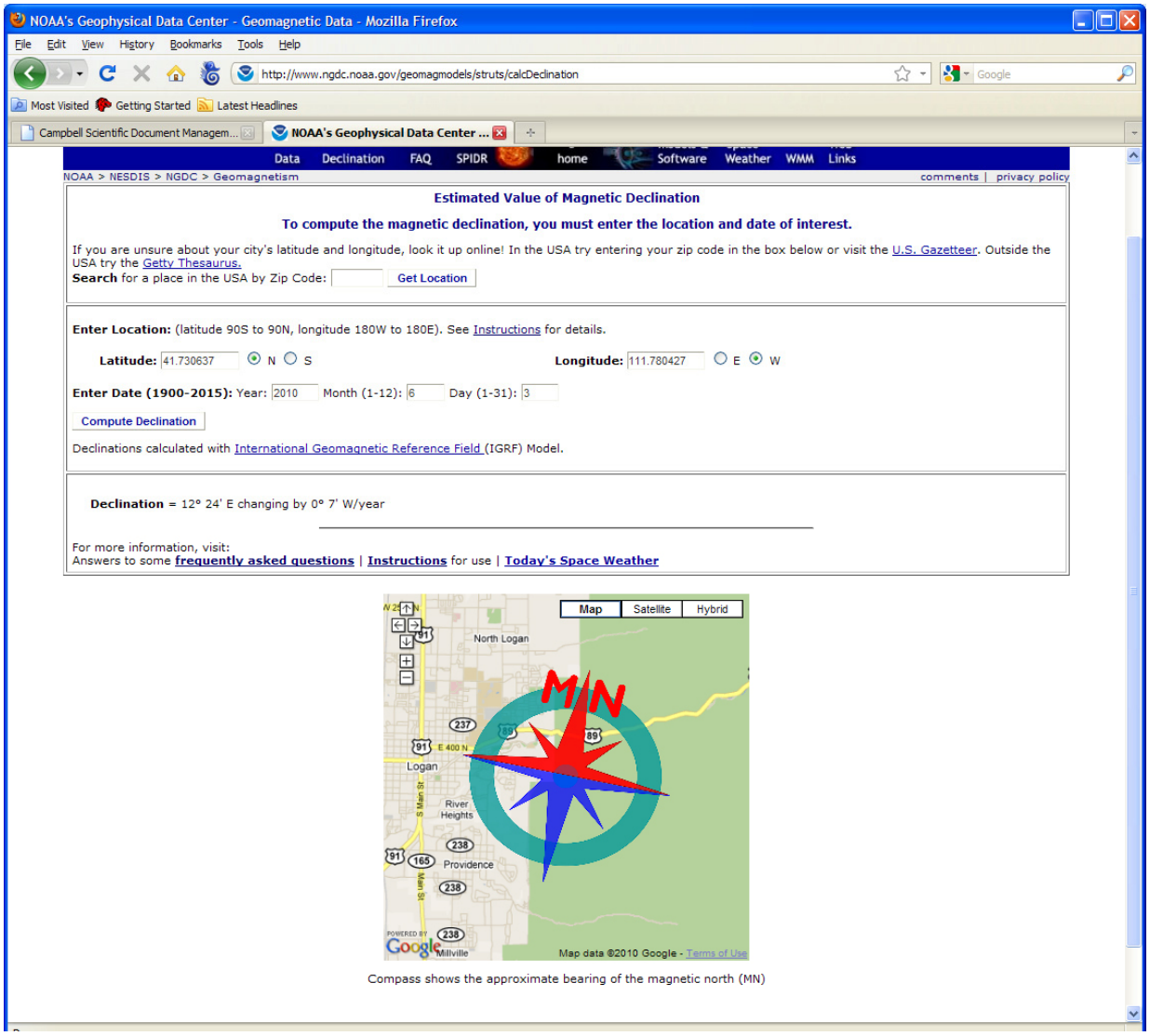
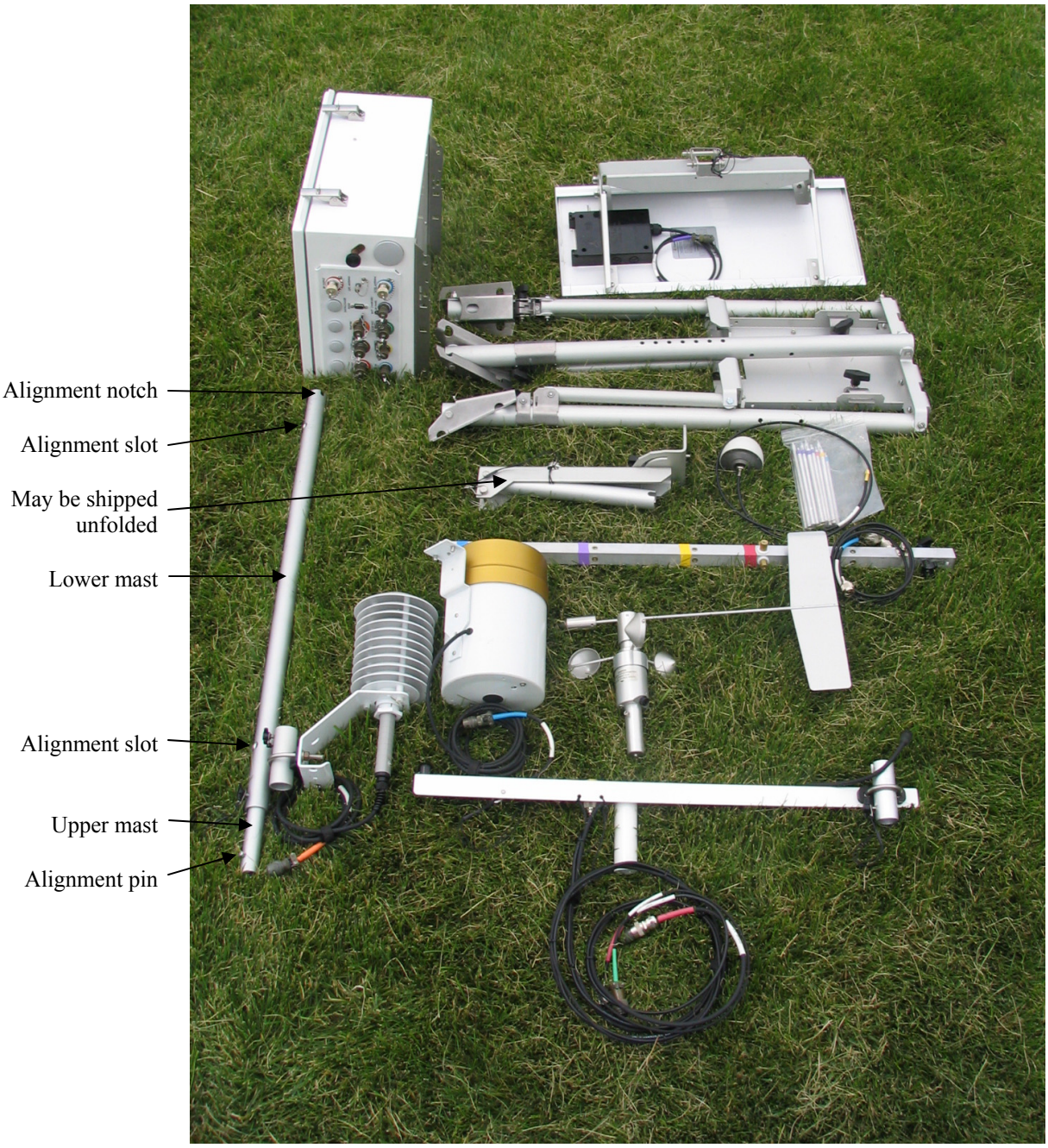

NOAA's Geophysical Data Center - Geomagnetic Data - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://www.ngdc.noaa.gov/geomagmodels/struts/calcDeclination
Most Visited Getting Started Latest Headlines
Campbell Scientific Document Managem...
NOAA's Geophysical Data Center ...
Data Declination FAQ SPIDR home Software Weather WMM Links
NOAA > NESDIS > NGDC > Geomagnetism
comments | privacy policy
Estimated Value of Magnetic Declination
To compute the magnetic declination, you must enter the location and date of interest.
If you are unsure about your city's latitude and longitude, look it up online! In the USA try entering your zip code in the box below or visit the U.S. Gazetteer. Outside the USA try the Getty Thesaurus.
Search for a place in the USA by Zip Code:
Get Location
Enter Location: (latitude 90S to 90N, longitude 180W to 180E). See Instructions for details.
Latitude: 41.730637 N S
Longitude: 111.780427 E W
Enter Date (1900-2015): Year: 2010 Month (1-12): 6 Day (1-31): 3
Compute Declination
Declinations calculated with International Geomagnetic Reference Field (IGRF) Model.
Declination = 12° 24' E changing by 0° 7' W/year
For more information, visit:
Answers to some frequently asked questions | Instructions for use | Today's Space Weather
Map Satellite Hybrid
North Logan
Logan
River Heights
Providence
Millville
MN
Map data ©2010 Google - Terms of Use
Compass shows the approximate bearing of the magnetic north (MN)

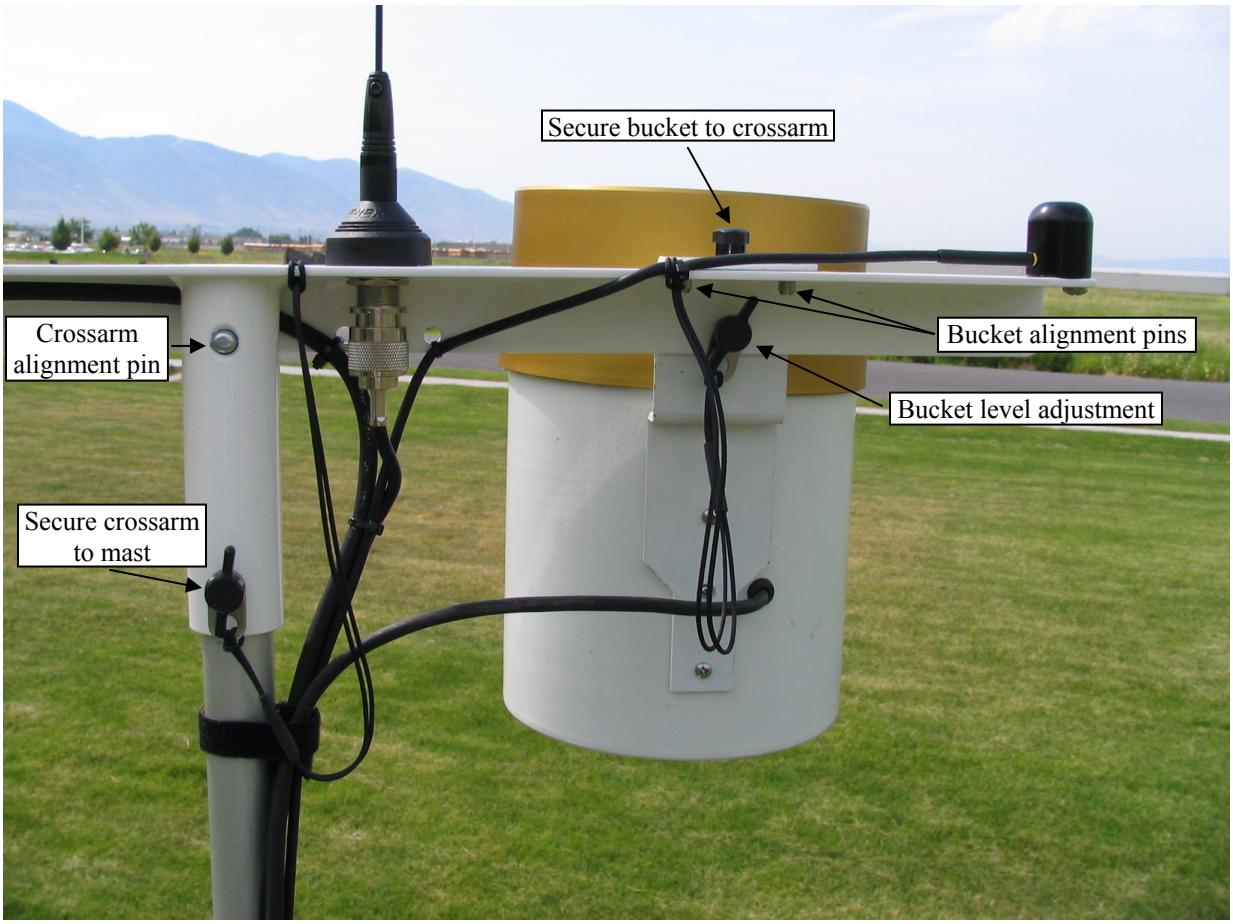
FIGURE 8.3-4. USGS web calculator

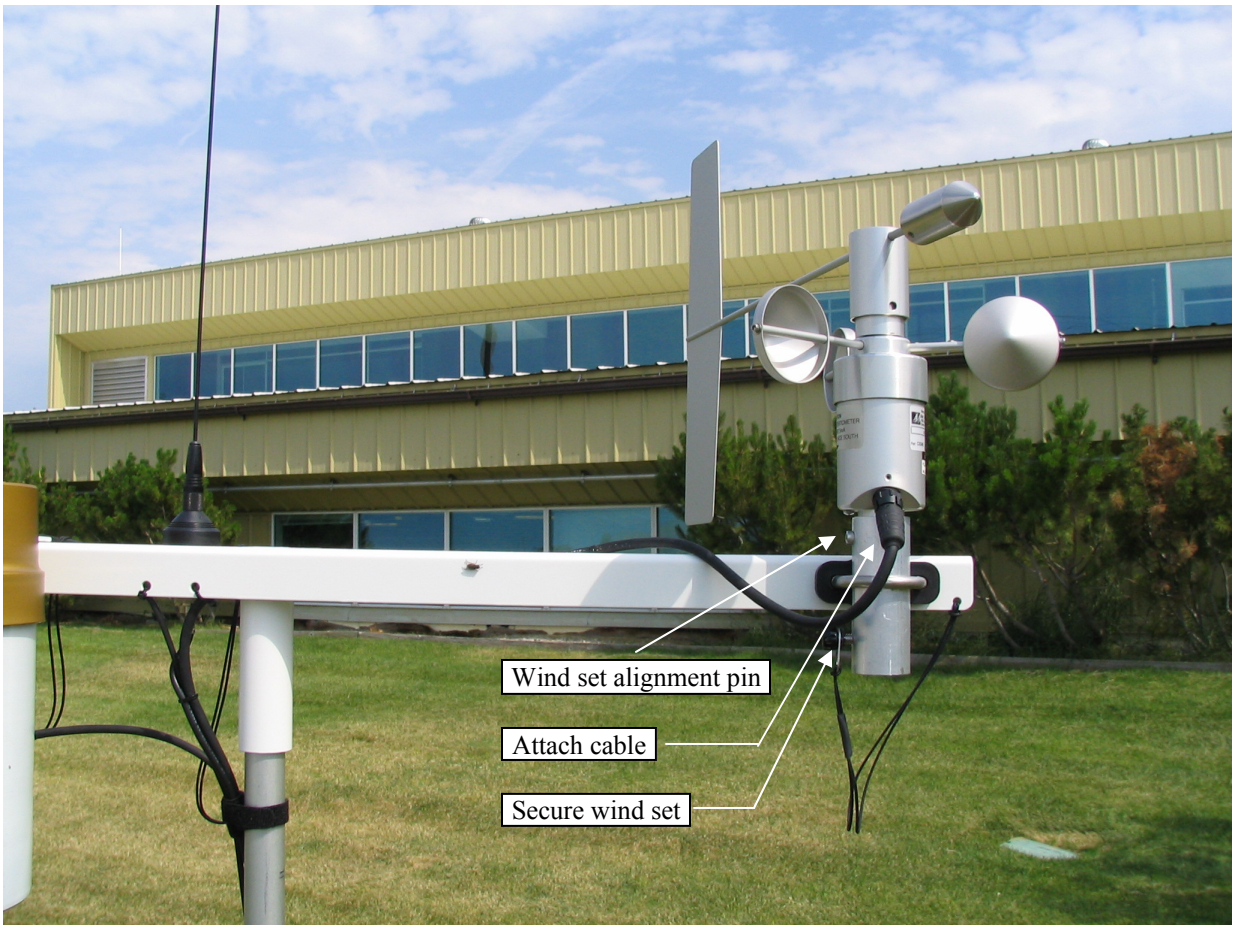
In the example above the declination for Logan, UT is 12º 24′ or 12.4º. As shown in Figure 9.3-4, the declination for Utah is east (positive), so True North for this site is 360 – 12.4 = 347.6 degrees. The annual change is 7 minutes west per year or -7 minutes/year.

Appendix A. Assemble the RAWS-F Station



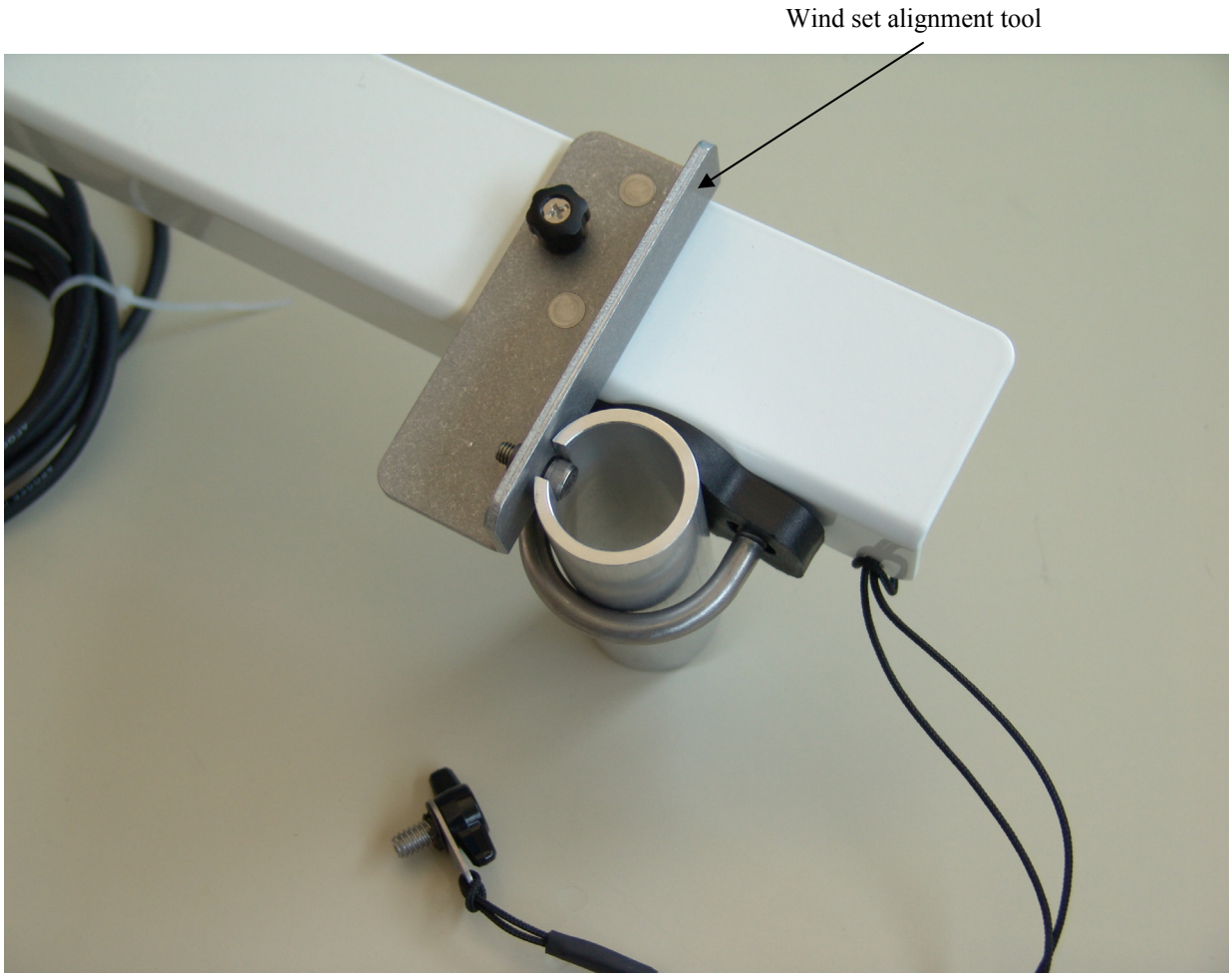
Bulls-eye level
Secure lower mast
Alignment nut
Alignment notch facing in
Level adjustment lever


Secure bucket to crossarm
Crossarm alignment pin
Bucket alignment pins
Bucket level adjustment
Secure crossarm to mast


Wind set alignment pin
Attach cable
Secure wind set

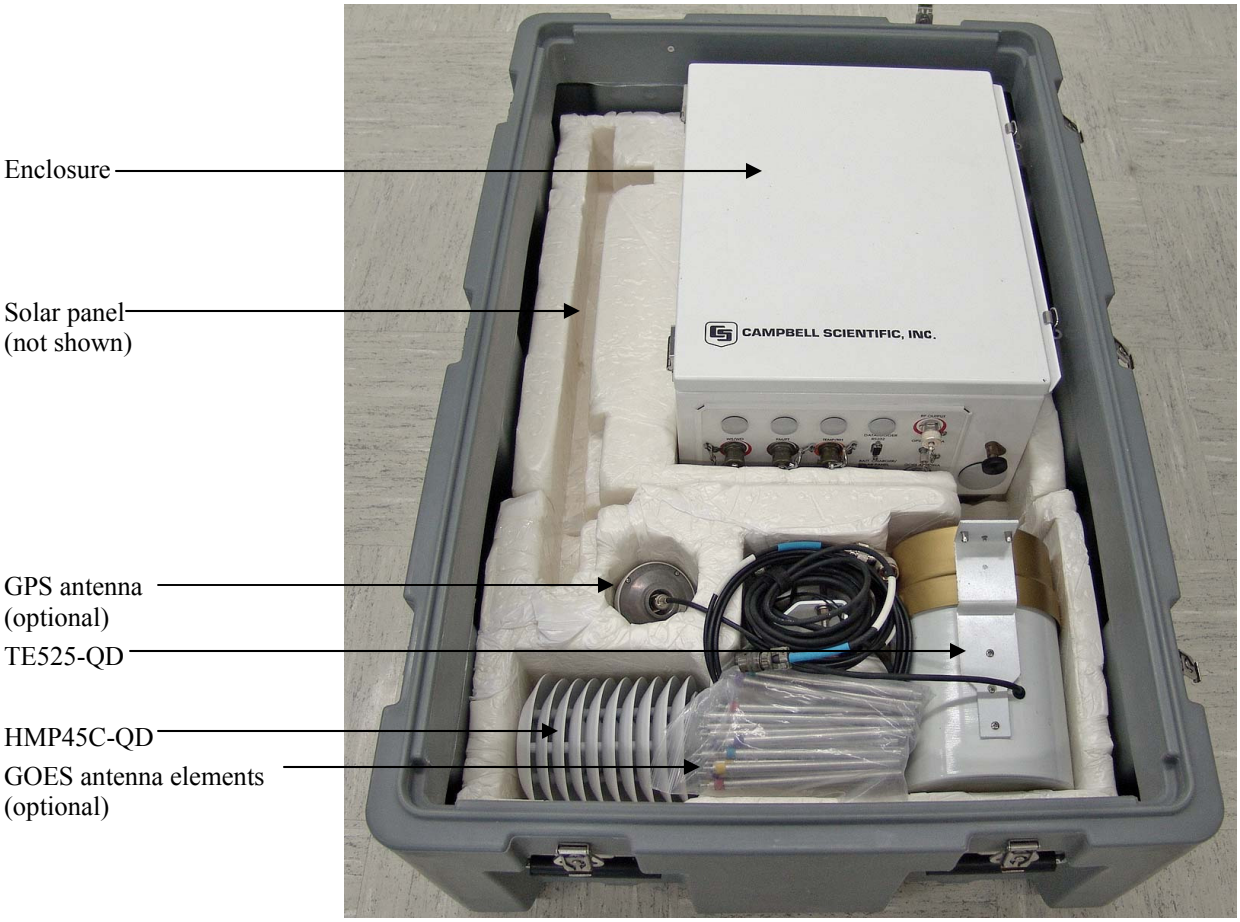
Enclosure
hanger points

Optional transport cases

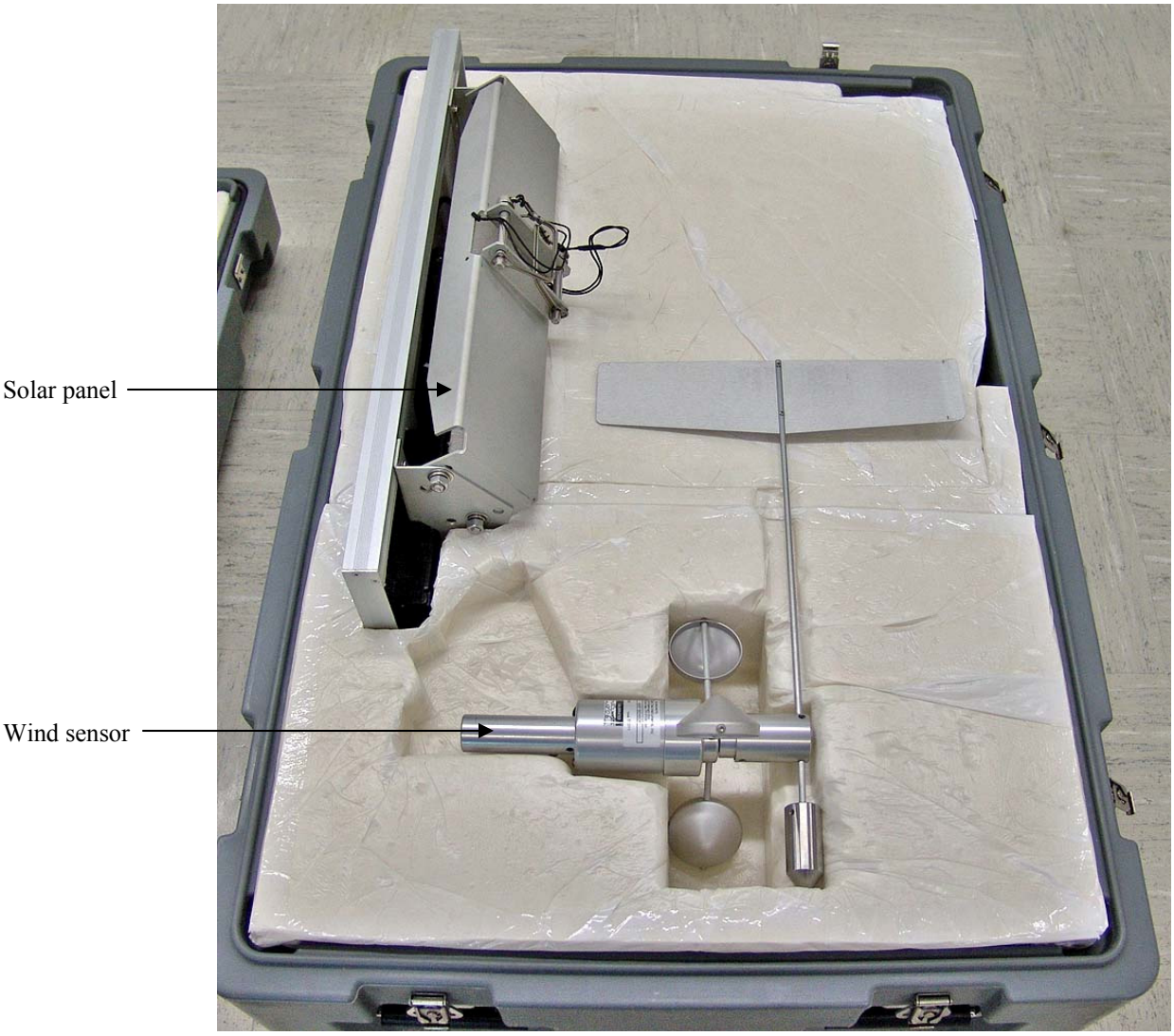

Wind set alignment tool

Appendix B. Transport Cases (Optional)

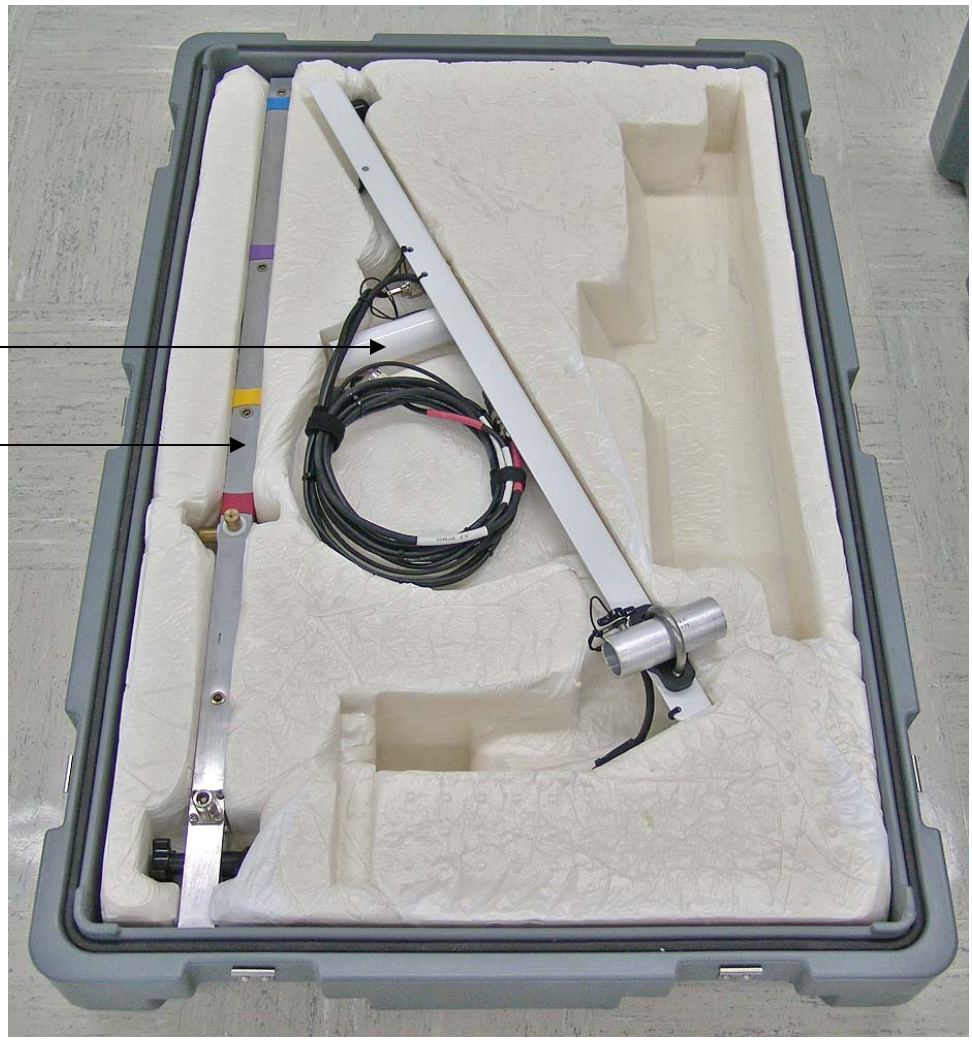
Hard transport case (optional)



Hard transport case "base" layer (1 of 2)
Note: optional components also shown



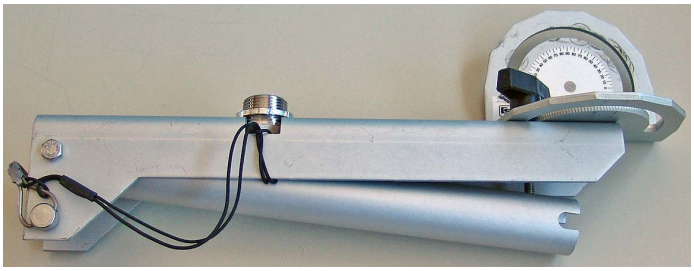
Hard transport case “base” layer (2 of 2)



Hard transport case "lid" (1 of 1)
Note: optional components also shown

Canvas transport case (optional)

Canvas transport case
Note: optional components also shown



GOES and GPS mounting arm (optional)

Grounding assembly and tripod stake

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